PHYTOTOXICOLOGY REPORT

LAIDLAW ENVIRONMENTAL

SERVICES LTD.,

CORUNNA, 1992

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ABSTRACT

Analysis of tree foliage for inorganic parameters reaffirmed the results of previous studies that emissions from the facility are not having a measurable impact on the surrounding terrestrial environment. A limited survey of soils in the vicinity of the facility also found that concentrations of dioxins and furans were within background limits and not detectibly elevated near the facility.

BACKGROUND and INTRODUCTION

Laidlaw Environmental Services, formerly known as Tricil Ltd., operates a hazardous waste landfill and incineration facility in Corunna, Ontario. The facility has generated much local concern and scientific attention.

The Phytotoxicology Section, Hazardous Contaminants Branch, of the Ministry of the Environment and Energy (MOEE) has been involved in soil and vegetation assessments in the vicinity of the facility since 1977. During this time the Section has conducted annual surveys and investigated a number of vegetation damage complaints from local property owners. To date, none of the vegetation complaints identified contaminants migrating off the site in soil, water or air.

Annual vegetation, soil and/or moss bag surveys have been conducted in the vicinity of the facility on 13 occasions since 1977. These surveys examined inorganic contaminants only. The number and location of sampling stations, the material sampled and the frequency of sampling have been varied from year to year to expand or reduce the information base and to respond to changes in processes at the facility. The following table summarizes the type of sampling that was conducted in each of the sampling years and the number of sampling sites involved.

Table 1: Surveys Conducted in the Vicinity of Laidlaw Environmental Services, Corunna - 1977 to 1991.

Year	# of Stations	Material Sampled			
		Silver Maple Foliage	Grass	Soil	Moss Bags
1977	30	X		X	
1978	30	X	X	X	
1980	30	X	X		
1981	30	X	X		
1982	9	X	X		
1983	8	X			
1984	12	X			
1985	12	X			
1986	12	X			
1987	12	X			
1989	20 (39)	X		X	X
1990	20 (39)	X			X
1991	20	X			

Note: Station numbers in brackets refer to moss bag collections only.

Annual surveys conducted up to 1984 found no evidence of vegetation contamination in the vicinity of Laidlaw. Slightly elevated concentrations of inorganic contaminants were found near the facility in 1985 through 1990. Specifically, in 1989 and 1990, aluminum, barium, calcium, cadmium and manganese were elevated in silver maple collected around Tricil but radial concentration gradients were not strong. A second group of elements had very low and consistent background levels with a marginal but distinct concentration gradient associated with the Tricil location. These included chromium, lead and mercury (mercury only in 1990). Even though these two groups of elements were elevated, none exceeded their corresponding rural ULN guideline. Moss bags also had elevated concentrations of calcium, chromium and magnesiun in 1989 and 1990. There was no evidence, however, that soils collected around the facility in 1990 had been impacted by the facility[1]. Although a number of elements also demonstrated concentration gradients associated with Laidlaw in 1991 (ie. aluminum, barium, cadmium, calcium, chromium, lead, manganese and zinc), none exceeded their corresponding ULN guideline. In addition, the zones of contamination tended to be smaller and less distinct in 1991 compared to 1989 and 1990[2]. The report summarizing the 1991 data concluded that the degree of contamination was environmentally inconsequential and would not interfere with the normal use of the land.

This report summarizes the results of field activities conducted in the vicinity of Laidlaw Environmental Services Limited, Corunna, in 1992.

METHODOLOGY

Vegetation and soil collections in the vicinity of Laidlaw were conducted by J. Craig Kinch and D. McLaughlin, on September 17, 1992. The survey was conducted in a similar manner to those in the past, with the following notable exceptions. Because extensive studies conducted by the Phytotoxicology Section over the past 15 years have demonstrated, at most, only marginal terrestrial impacts associated with the facility, the number of stations sampled and the number of inorganic parameters tested were reduced. The survey was reduced from 20 stations in 1991 to 11 stations in 1992 (see figure). These stations were selected to include locations close to and in the documented downwind gradient of the facility, as well as control locations. The number of inorganic parameters tested in 1992 was also reduced from 29 to 8. Elements of specific concern and/or shown in the past to be associated with emissions from Laidlaw were lead [Pb], manganese [Mn], aluminum [Al], barium [Ba], cadmium [Cd], chlorine [Cl], mercury [Hg] and magnesium [Mg].

Duplicate foliar samples from silver maple trees were collected from each of the 11 stations. Samples were collected using pole pruners from the mid-crown of sample trees on the side of the crown facing Laidlaw. Samples were stored in plastic bags during transport to the Phytotoxicology processing lab. Samples were oven-dried, ground in a Wiley-mill and stored in glass bottles. Processed vegetation samples were submitted to the MOEE laboratory in Etobicoke for chemical analysis.

Surface soil (0-5 cm) samples were also collected from 4 of the tree foliage sample stations. These samples were analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) by the Dioxin Unit of the MOEE Laboratory Services Branch. This is the first year that PCDD/DF analysis were conducted on terrestrial samples collected for the Phytotoxicology

Laidlaw Survey. Three of the stations were close to the facility in the area where marginally elevated inorganic concentrations had been previously detected, and the fourth was collected from an upwind control location. All samples were collected from residential lawns. Single soil samples were collected from a 100 m^2-area at each station. Each sample consisted of a minimum of 50 individual cores collected from random locations within the sample area using a stainless steel corer.

RESULTS and DISCUSSION

The results of analysis of silver maple foliage are presented in Table 2. Concentration contour maps, similar to those in previous Phytotoxicology reports, were not produced for inorganic elements in foliage because of the limited number of stations sampled in 1992. However, the prevailing winds during the non-winter months are from the west south-west, therefore emissions from the Laidlaw facility would be deposited predominantly to the east north-east.

In general, results of the 1992 foliar chemical analysis were similar to those found in 1991. With the exception of chlorine, there were no exceedences of the rural ULNs for any of the elements tested. While concentrations of some elements tended to be slightly elevated in 1992 compared to 1991, the differences were not consistently associated with stations suspected to be influenced by the facility. For example, on average manganese and mercury were marginally elevated in silver maple foliage in 1992 compared to 1991. However, this trend was consistent for most stations, both close and downwind and those distant and upwind. In the case of mercury, foliar concentrations in 1992 remained very close to the analytical detection limit and well below established MOE guidelines. In addition, the differences between the 1991 and 1992 data are marginal, and do not represent a trend towards either increasing or decreasing concentrations. As with previous studies, elevated chlorine concentrations could not be attributed to Laidlaw, but rather were almost certainly the result of natural salt deposits known to be common in Lambton county.

Dioxins and furans, while never deliberately manufactured, may be formed whenever chlorinated compounds are incinerated. Therefore, soils were collected from a limited number of stations and analyzed for dioxins and furans as a screening-level check on emissions of these compounds from the Laidlaw facility. The results of the analyses are summarized in Table 3. The data are expressed in picograms of PCDD/PCDF per gram of sample (parts per trillion, ppt). The data are summarized by total concentration in each congener group (isomers with the same number of atomic substitutions). For example, the congener T_4CDD stands for tetra-chlorinated dibenzo p-dioxin, meaning that there are 4 chlorine atoms attached to the ring structure that forms the basis of the dioxin molecule. Furans, although distinct, are associated with dioxins and coded in the same way. Therefore, *dioxin* and *furan* actually refer to classes of compounds which intum refer to a large number of similar compounds. Generally, furans are less toxic than dioxins and toxicity decreases with increasing degree of chlorination. The most often discussed dioxin compound and the isomer considered to be the most toxic is 2,3,7,8-T_4CDD. Concentrations of individual 2,3,7,8-substituted isomers of dioxins and furans in soils are also presented in Table 3.

Because of the varying toxicities and relative abundance of the isomers and the congener groups, a system has been developed to combine the individual dioxin and furan results into one number that expresses the toxicity in relation to the most toxic of the compounds, 2,3,7,8-T_4CDD. This is referred to as the TEQ, or Toxic Equivalent. The dioxin and furan data in Table 3 were

converted to TEQs using the International Toxicity Equivalency Factors[3] and the isomer substitution formula derived by the MOEE Hazardous Contaminants Branch[4]. An interim guideline of 1000 pg/g TEQ for residential/parkland soil has been proposed[5].

The high resolution of the MOEE dioxin laboratory permits the detection of extremely low concentrations of dioxins and furans in soil. With one exception (H6CDF at Site 15), measurable concentrations of all congeners were detected in soils collected from all sample sites. The mean TEQ for the three sites located downwind of the facility was 2.4 pg/g compared to a TEQ of 22.5 pg/g for the upwind control site. In no case did the TEQ exceed the guideline of 1000 pg/g for residential/parkland soils. In addition, the concentrations of all congener groups were well within the range of concentrations detected in background rural and urban Ontario soils[6]. The limited data, therefore, do not implicate Laidlaw as a source of dioxins/furans in soil in the vicinity of the facility.

CONCLUSIONS

Analysis of tree foliage for inorganic parameters collected from a reduced number of sample sites, in the vicinity of Laidlaw, re-affirmed the results of previous studies that emissions from the facility are not having a measurable impact on the surrounding terrestrial environment. A limited survey of soils in the vicinity of the facility also found that concentrations of dioxins and furans were within background limits and not detectibly elevated near the facility.

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Table 2: Concentrations* of Chemical Elements in Silver Maple Foliage Collected in the Vicinity of Laidlaw Environmental Services, Corunna - September 1992 and 1991.

Site	Location (approximate)	Pb		Mn		Al		Ba		Cd		Cl		Hg		Mg	
		1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991
2	5000 m S	DL	DL	11	12	53	65	4.9	5.7	DL	0.1 T	3800	3200	0.04 T	0.03 T	3500	3800
11	4000 m E	0.8 T	0.6 T	31	27	86	160	6.4	5.9	0.1 T	0.1 T	4700	3700	0.04 T	0.03 T	3000	3000
13	2000 m E	DL	DL	110	120	79	100	10	10	DL	DL	4800	2700	0.05 T	0.03 T	3800	4600
15	50 m N	1.4 T	1.8 T	20	30	76	120	9.2	10	0.2 T	0.2 T	5200	6300	0.04 T	0.04 T	3700	4200
17	150 m W	0.7 T	DL	33	18	71	120	4.0	4.5	DL	DL	700	1500	0.04 T	0.02 T	3000	3200
20	5500 m W	0.5 T	DL	52	27	55	77	3.3	3.5	DL	DL	1200	1100	0.03 T	0.03 T	2900	2800
22	2500 m N	0.9 T	0.8 T	22	17	62	63	5.0	5.2	DL	0.1 T	1500	1600	0.02 T	0.02 T	2800	3100
23	5000 m NE	0.7 T	0.7 T	74	44	76	70	7.9	6.0	0.1 T	0.1 T	5800	4400	0.04 T	0.03 T	4500	5000
24	3500 m NE	1.1 T	1.4 T	71	41	74	130	7.3	6.2	0.2 T	0.1 T	5900	2600	0.05 T	0.03 T	4400	3200
29	6000 m N	DL	0.5 T	30	17	43	42	6.1	4.8	DL	DL	5500	5000	0.03 T	0.01 T	2600	2900
30	7000 m NE	DL	1.1 T	17	18	45	97	5.6	5.9	DL	0.1 T	900	5300	0.05 T	0.03 T	3500	3500
ULN		30		NG		500		NG		1		1500		0.1		7000	

* ug/g dry weight, mean of duplicate samples and analysis
DL below the analytical method reporting limit
T trace amounts or tentative estimates
ULN Phytotoxicology Upper Limit of Normal guidelines, see Appendix
NG no guideline, ULN not established
Values underlined and in bold exceed established ULN guideline.

Table 3: Analytical Results for Polychlorinated Dibenzo-p-dioxins (PCDD) And Polychlorinated Dibenzofurans (PCDF) in the Vicinity of Laidlaw Environmental Services, Corunna, 1992.

Sample description	SITE 15	SITE 13	SITE 24	SITE 02
T4CDD	4.9^{2} (0.25)	2.7^{2} (0.14)	2.5^{2} (0.13)	3.4^{3} (0.17)
P5CDD	2.7^{1} (0.14)	5.8^{4} (0.29)	6.0^{5} (0.30)	14^{7} (0.70)
H6CDD	10^{2} (0.30)	10^{3} (0.30)	13^{3} (0.39)	110^{6} (3.3)
H7CDD	45^{2} (0.36)	30^{2} (0.24)	72^{2} (0.58)	930^{2} (7.4)
O8CDD	140 (0.14)	80 (0.08)	200 (0.20)	3700 (3.7)
T4CDF	20^{4} (0.20)	13^{9} (0.13)	7.9^{6} (0.08)	18^{11} (0.18)
P5CDF	15^{2} (1.1)	3.8^{1} (0.29)	4.5^{2} (0.34)	9.3^{2} (0.70)
H6CDF	ND	3.1^{1} (0.16)	12^{3} (0.60)	100^{5} (5.0)
H7CDF	24^{2} (0.12)	12^{2} (0.06)	26^{2} (0.13)	140^{2} (0.70)
O8CDF	18 (0.02)	7.8 (0.008)	27 (0.03)	690 (0.69)
2,3,7,8-T4CDD Toxic Equivalents*	2.63	1.70	2.78	22.5
		2,3,7,8-Substituted Isomers		
2,3,7,8-TCDD	ND(2)	ND(1)	ND(1)	ND(1)
1,2,3,7,8-PCDD	ND(2)	ND(1)	ND(1)	2.4
1,2,3,4,7,8-H6CDD	ND(5)	ND(2)	ND(1)	6.5
1,2,3,6,7,8-H6CDD	ND(5)	ND(1)	ND(2)	22
1,2,3,7,8,9-H6CDD	ND(5)	ND(1)	ND(2)	14
1,2,3,4,6,7,8-H7CDD	25	17	37	620
2,3,7,8-TCDF**	5.0	2.2	1.3	3.0
1,2,3,7,8-PCDF	ND(4)	ND(2)	ND(1)	ND(2)
2,3,4,7,8-PCDF	ND(3)	ND(2)	ND(1)	ND(2)
1,2,3,4,7,8-H6CDF	ND(8)	ND(3)	3.7	ND(20)
1,2,3,6,7,8-H6CDF	ND(7)	ND(3)	ND(1)	2.7
2,3,4,6,7,8-H6CDF	ND(8)	ND(3)	ND(2)	4.9
1,2,3,7,8,9-H6CDF	ND(7)	ND(3)	ND(2)	ND(1)
1,2,3,4,6,7,8-H7CDF	12	5.2	11	130
1,2,3,4,7,8,9-H7CDF	ND(3)	ND(2)	ND(2)	7.6

- All concentrations expressed in ppt (parts-per-trillion; picograms (10^{-12} grams) of PCDD/PCDF per gram of sample).
  Values are corrected for recovery of isotopically labelled surrogate standards.
- "ND" Not detected. Detection limit in ppt given in brackets ( ).
- Superscripts indicate the number of isomers detected.

( ) Values in brackets represent 2,3,7,8-T4CDD weighted Toxic Equivalency (TEQ) factors

* 2,3,7,8-T4CDD Toxic Equivalents (TEQ) - the sum of the weighted TEQ factors. Interim guideline is 1000 pg/g for residential/parkland soils (Birmingham, 1991)

** Maximum concentration due to chromatographic overlap.

Soil and Vegetation Sampling in the Vicinity of Laidlaw Environmental Services Limited, Corunna